

# Introduction to Climate Change

EES 3310/5310

Global Climate Change

Jonathan Gilligan

Class #1: Monday, January 25 2021

# Some Housekeeping:

- The main class website is at <https://ees3310.jgilligan.org>
- Copies of the
  - syllabus,
  - reading assignments,
  - lab assignments,
    - readings
    - instructions
    - files you will use for the labs
  - slides from class (also link from QR code on title slide)
- Links to helpful resources.
- Slides:
  - The title slide has QR code with link to online version.
  - PDF versions are also posted to course web site (link on title slide)
  - Slides have two-dimensional navigation (in a browser, hit “?” for help)

Is the Climate Changing?

# Is the Climate Changing?

- What does it mean for climate to change?
- How would you know whether it's changing?

# Is the Climate Changing?

- 2020 was the hottest year on record.
- 2016 was the second hottest (statistical tie).
- 2019 was the third hottest.
- 2017 was the fourth hottest.
- 2015 was the fifth hottest.
- 2018 was the sixth hottest.

The last six years were the hottest six years on record.

19 of the 20 hottest six years on record happened in the last 20 years.

# Are People Causing Climate to Change?

- How can we tell?
- How certain can we be?

# How Will Climate Change Affect Our Lives in Years to Come?

- What kinds of changes might affect us?
- How can we tell whether they will happen?
  - And when?
  - And how severely?

## Dangerous heat waves becoming more common.

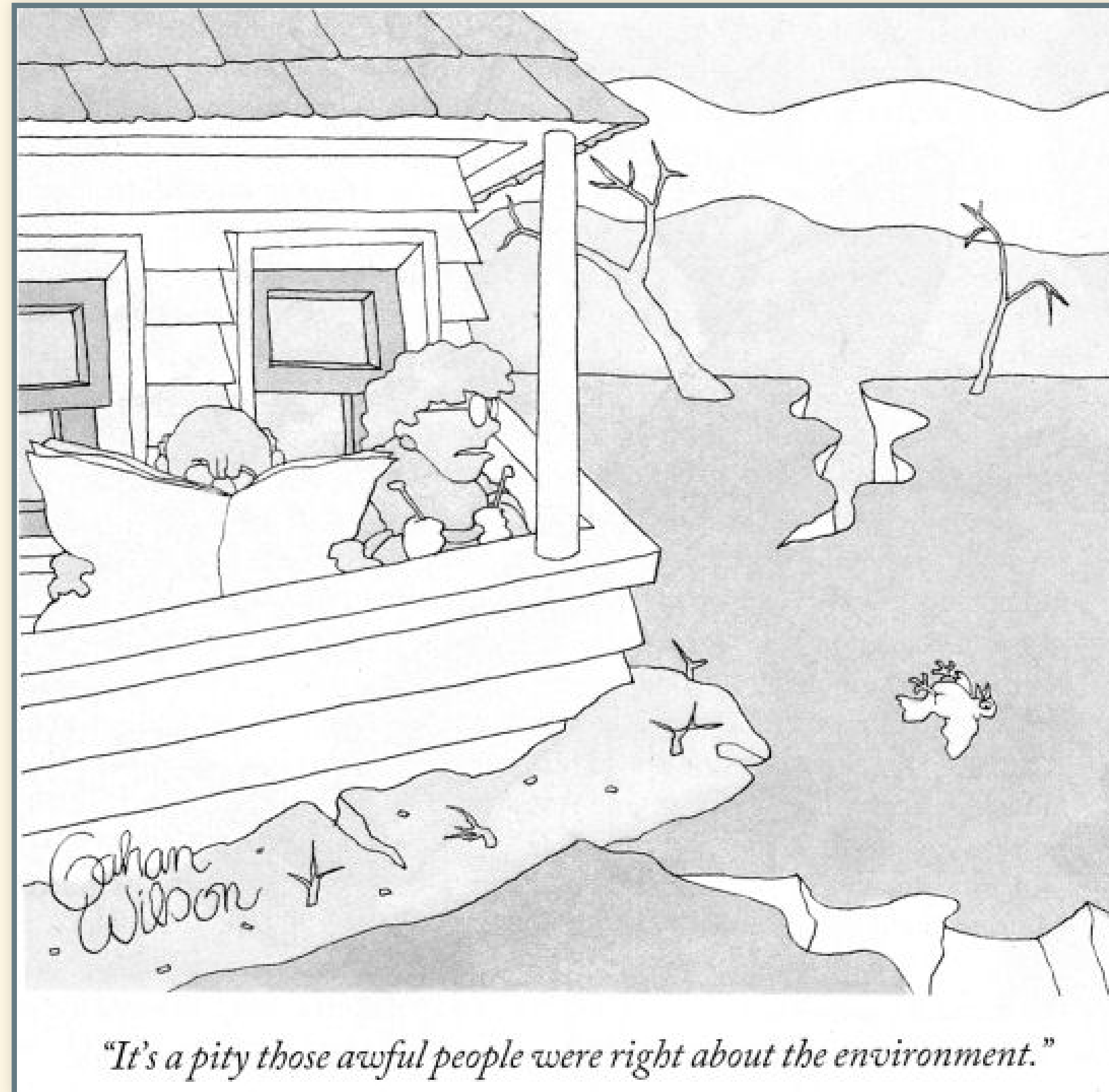
- Two of the ten deadliest heat waves in history happened in 2015.
- Six of the ten deadliest heat waves happened since 2000.
- Huge heat wave May/June 2017 stretching from Middle East to Europe and across Asia.
- June 2017 heat wave in Phoenix AZ was too hot for many airplanes to fly. More than 40 flights grounded.
- Summer 2020: Record-breaking temperatures in California, Siberia, etc.



What Does Science Say?

# How Can We Answer These Questions?

- How can you know whether climate is changing?
  - How can you know what's causing it?
  - How can you know what it will do in the future?
- 
- How can you persuade someone else?
  - What would you need to know to be more certain?
  - If it is a problem ...
    - What can we do about it?
    - What should we do about it?



*"It's a pity those awful people were right about the environment."*

# Nuts and Bolts about the Course

# Goals for the Course

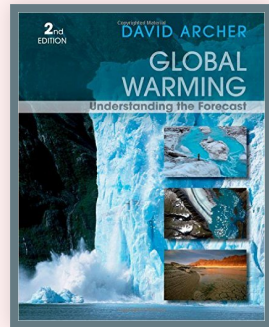
- Scientific Understanding:
  - What do we know about climate?
  - How do we know it?
  - How certain are we?
- Applied to:
  - Past climate conditions
  - Causes of climatic change
  - Predictions of future climate change
  - Impact of climate on people's lives

# Structure of the Course

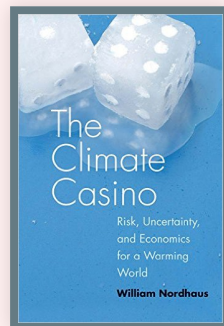
- Science
  - What determines the earth's temperature?
  - What are people doing that might change this?
  - What do we observe?
  - How will things change in the future?
- Policy:
  - How will these changes affect people's lives?
  - What can we do?
  - **How much will it cost?**
  - What actions will others agree to?

# Overview of the Semester

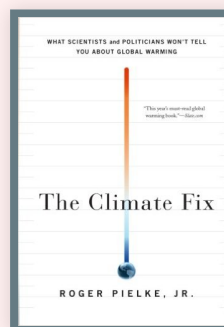
# Textbooks



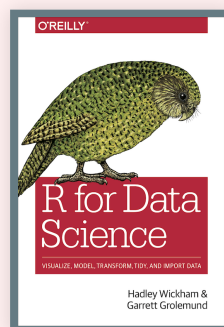
David Archer, Global Warming: Understanding the Forecast (2<sup>nd</sup> Edition)



William Nordhaus, The Climate Casino



Roger A. Pielke, Jr., The Climate Fix



Hadley Wickham & Garrett Grolemund, R for Data Science  
(Free web version online at <http://r4ds.had.co.nz/>)



# Laboratory

- Goals:
  - Download and analyze climate data
  - Work with interactive computer models
  - Learn about **reproducible research**
- Computational Tools:
  - Free, open source
  - R and RStudio for data analysis
  - Markdown and RMarkdown for writing reports
  - git and Github for managing files
- Today in lab:
  - Introduction to software tools
  - Be ready to use your computer to follow along.
  - Sign up for free account on [github.com](https://github.com)
- Later this week...
  - Read introductory documentation for lab tools
  - Start playing with R and RStudio
  - This week's lab is low-stakes: full credit for trying.
- Next Monday, we will begin learning R in depth and applying it to analyzing climate data.

# Class and Lab Material

- Main source of material: [ees3310.jgilligan.org](http://ees3310.jgilligan.org)
  - Syllabus
  - Reading assignments for the semester
    - Do the assigned reading **before** class on the day it's assigned for.
  - Reading and assignments for Lab
- Slides from class:
  - Web-based and PDF versions
  - Posted on [ees3310.jgilligan.org/schedule/](http://ees3310.jgilligan.org/schedule/)
  - Slides:
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# Participation

- Brightspace discussion boards:
  - Boards for asking questions about readings, labs, lectures
  - Board for weekly discussions
    - Each week, I will post a discussion question
    - Participation credit for making at least 2 posts:
      1. Starting a thread or making a very substantive comment on someone else's thread (by noon on Thursday)
      2. Responding to someone else (before the end of the day Sunday)
    - Be civil, respectful, and kind. It's fine to disagree, but do so constructively and respectfully.

# This week's discussion

Two things to do:

1. Introduce yourself to the class: Who are you, what are your interests, why are you interested in climate change?
2. The weekly discussion: Two questions about the readings for Wednesday. Choose one to respond to.

# Science, Policy, and Climate

# Science of Climate

- What determines earth's temperature?
  - Sunlight
  - Greenhouse effect
  - Other factors
- Chemistry of the atmosphere:
  - What are greenhouse gases?
  - What happens when people release them into the atmosphere?
- Consequences of climate change

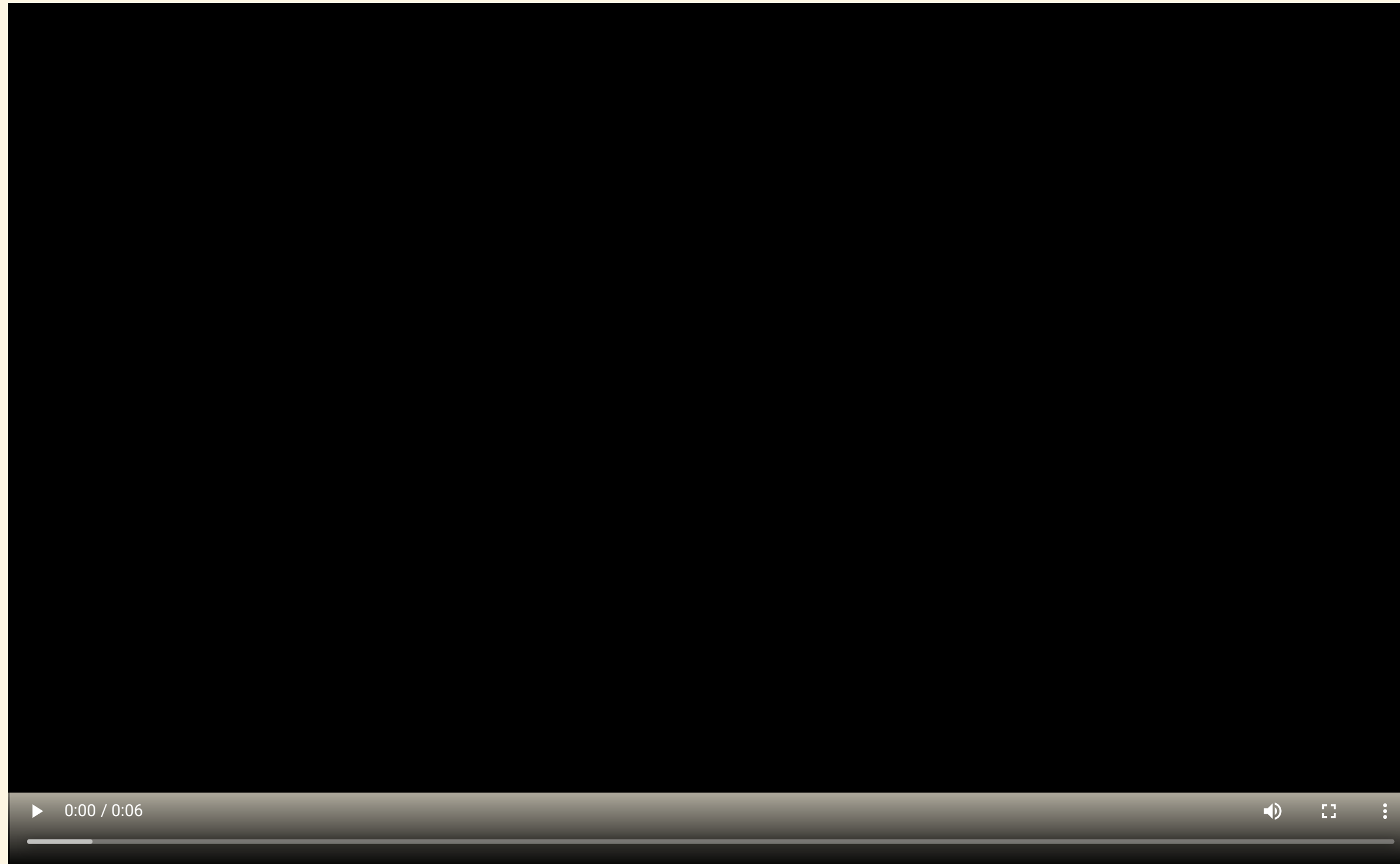
# Climate Policy

- What are consequences of climate change?
  - What alternatives to fossil fuels?
  - What would they cost?
- How to transition to low-carbon energy?
- Who should pay?
- How to build political agreement?

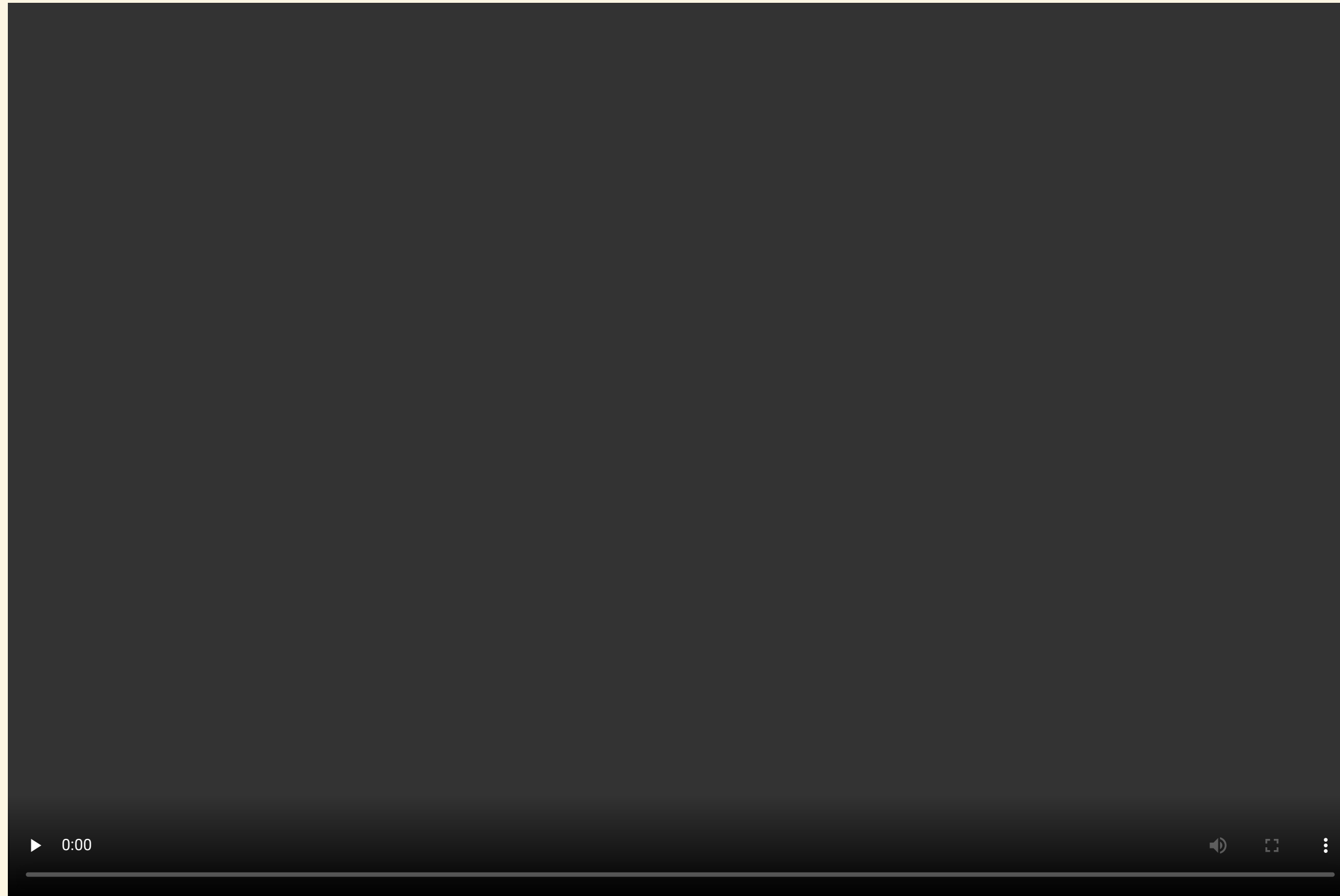
# How Politicians Talk about Climate Change



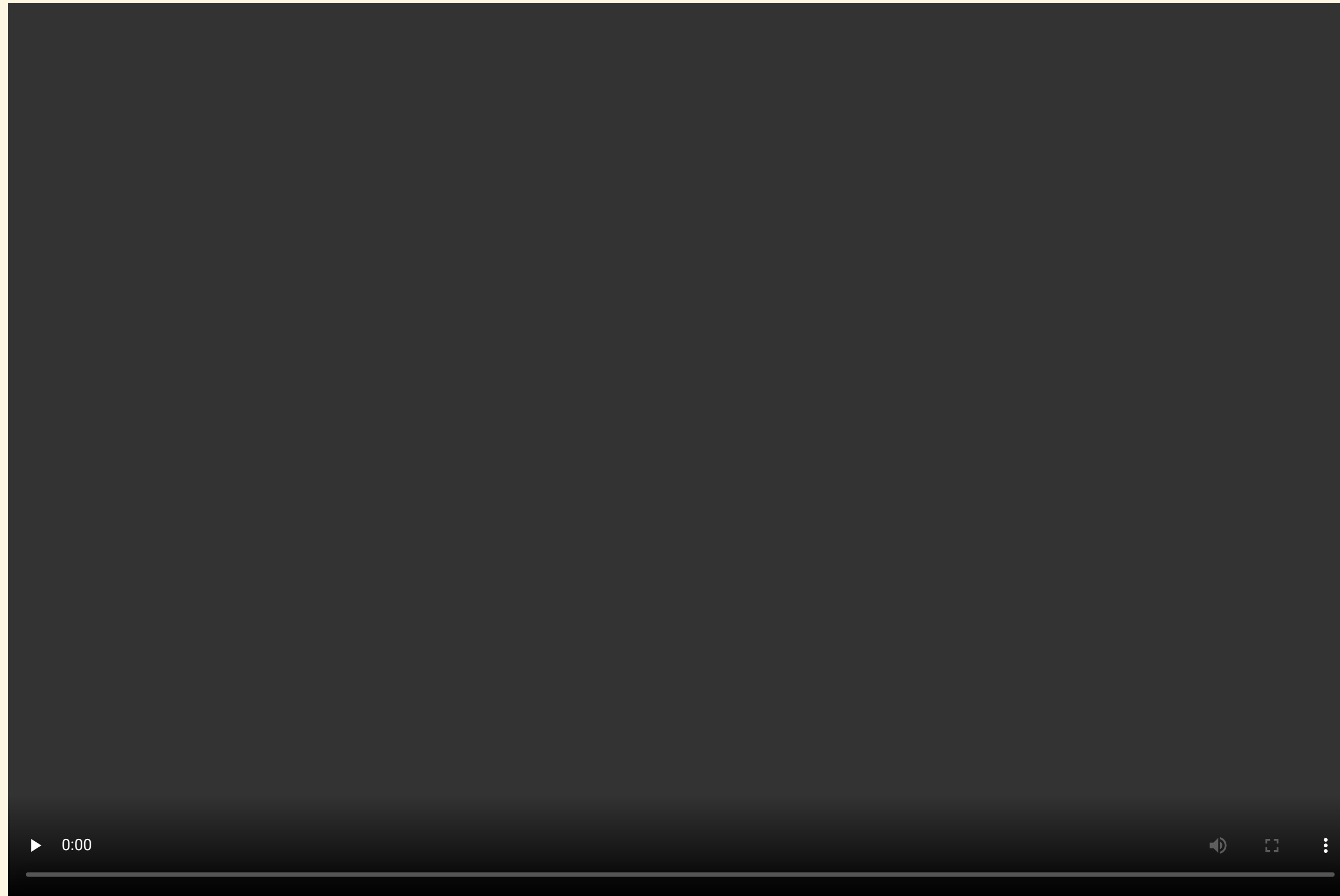
# Stereotype of Democrats



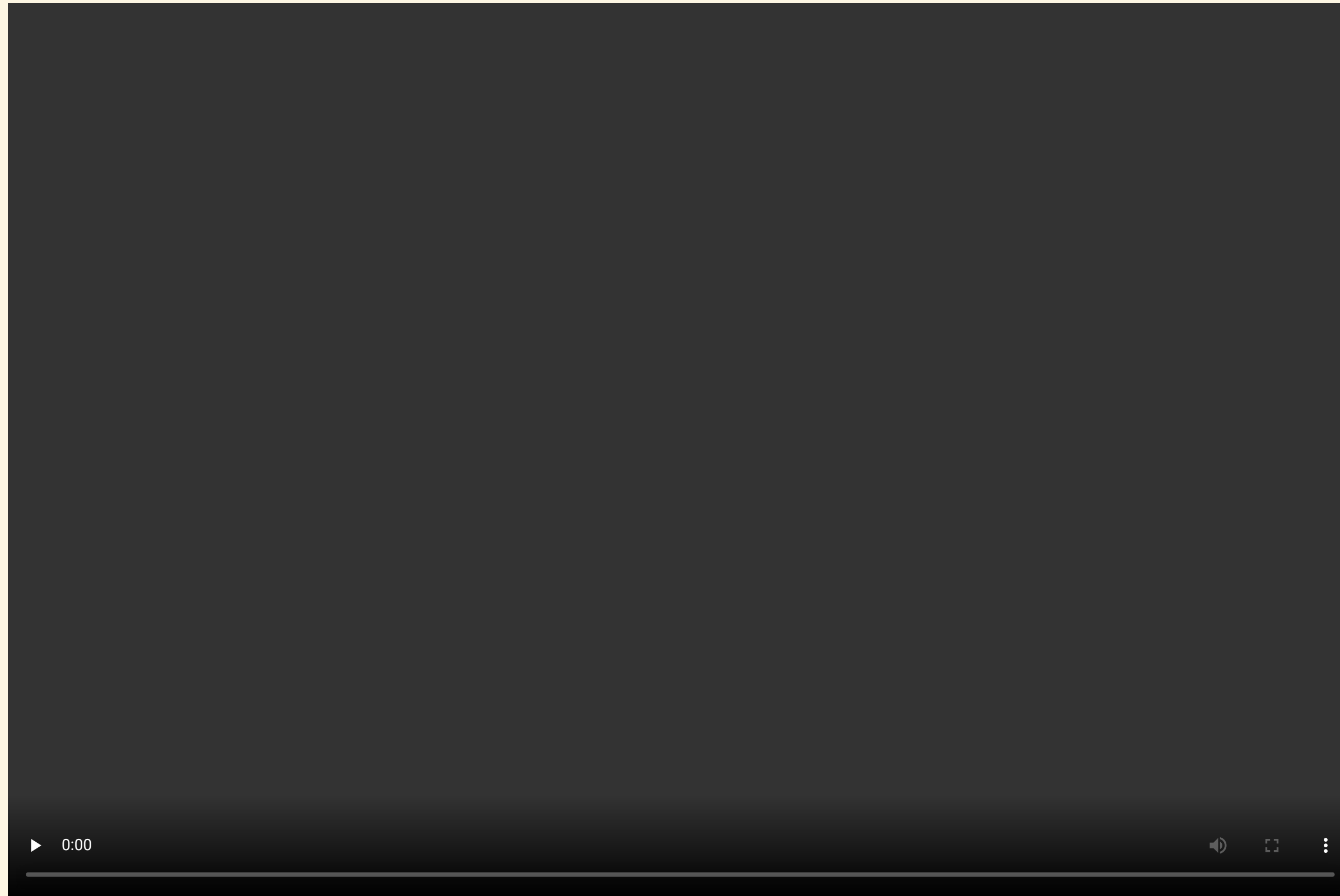
# Stereotype of Republicans



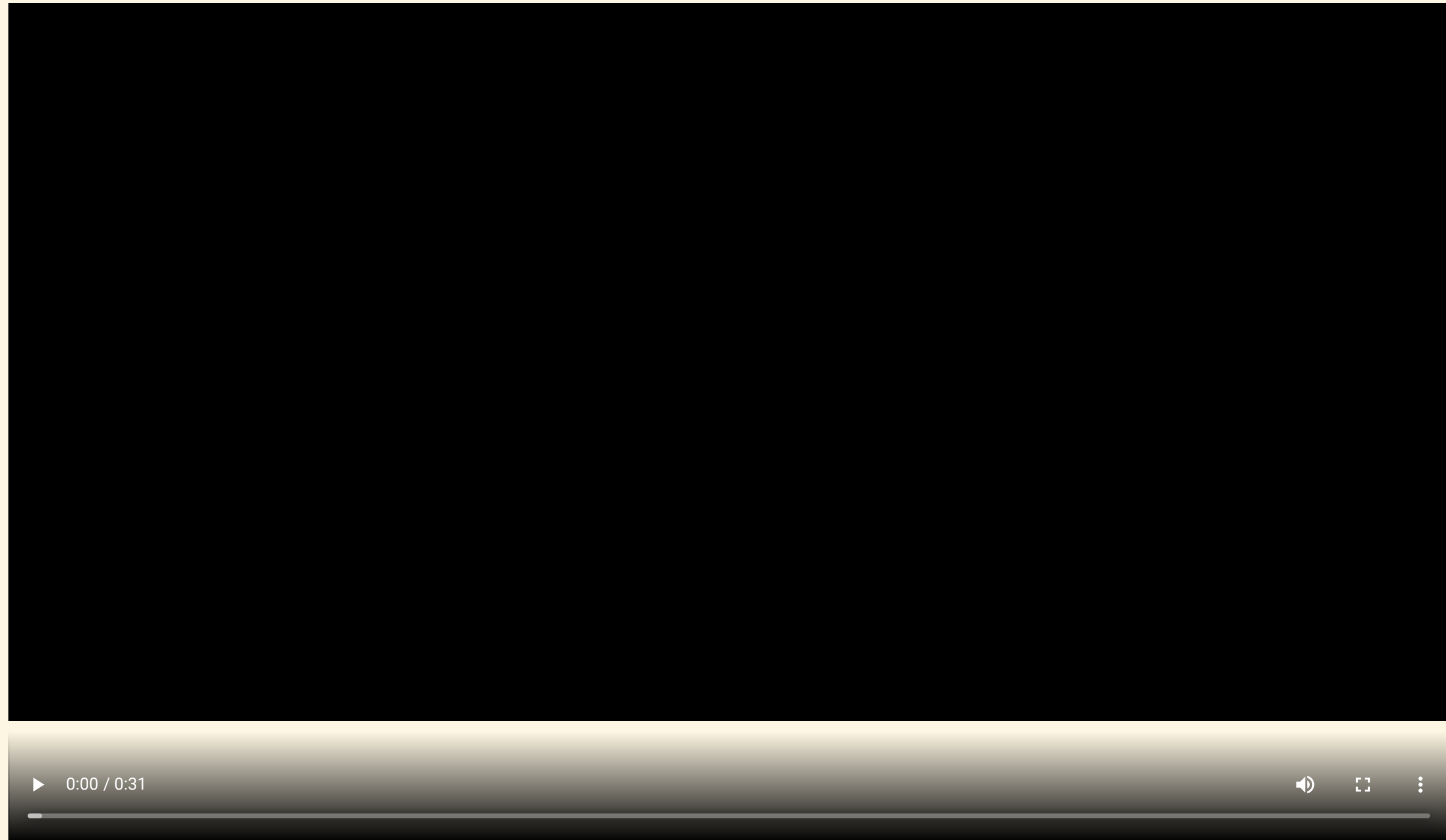
# It Wasn't Always Like This



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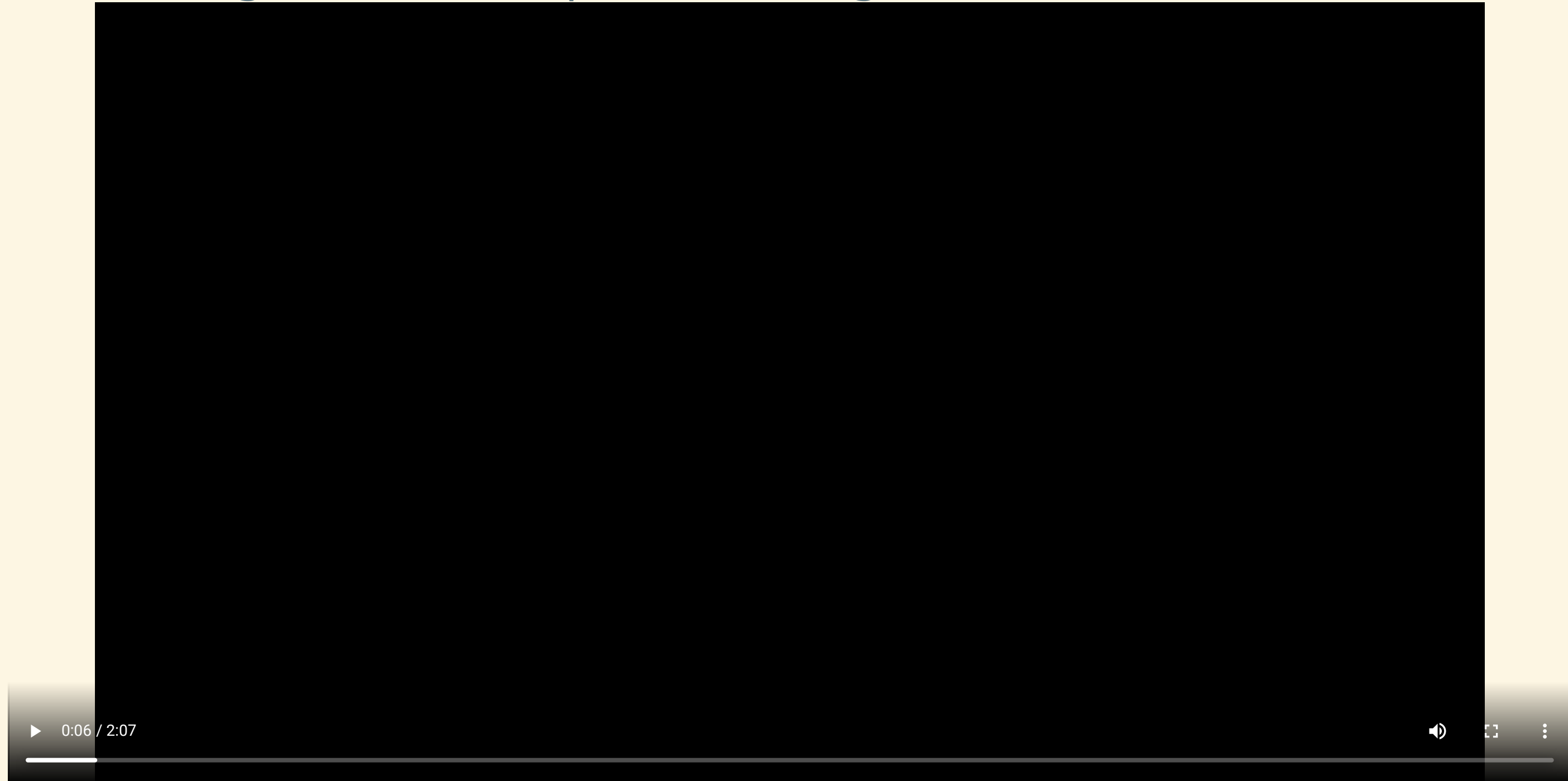


# It Wasn't Always Like This



# Today's GOP Climate Activists

- Arthur Laffer (Economic Adviser to President Reagan)
- Bob Inglis (Former Republican Congressman from South Carolina)

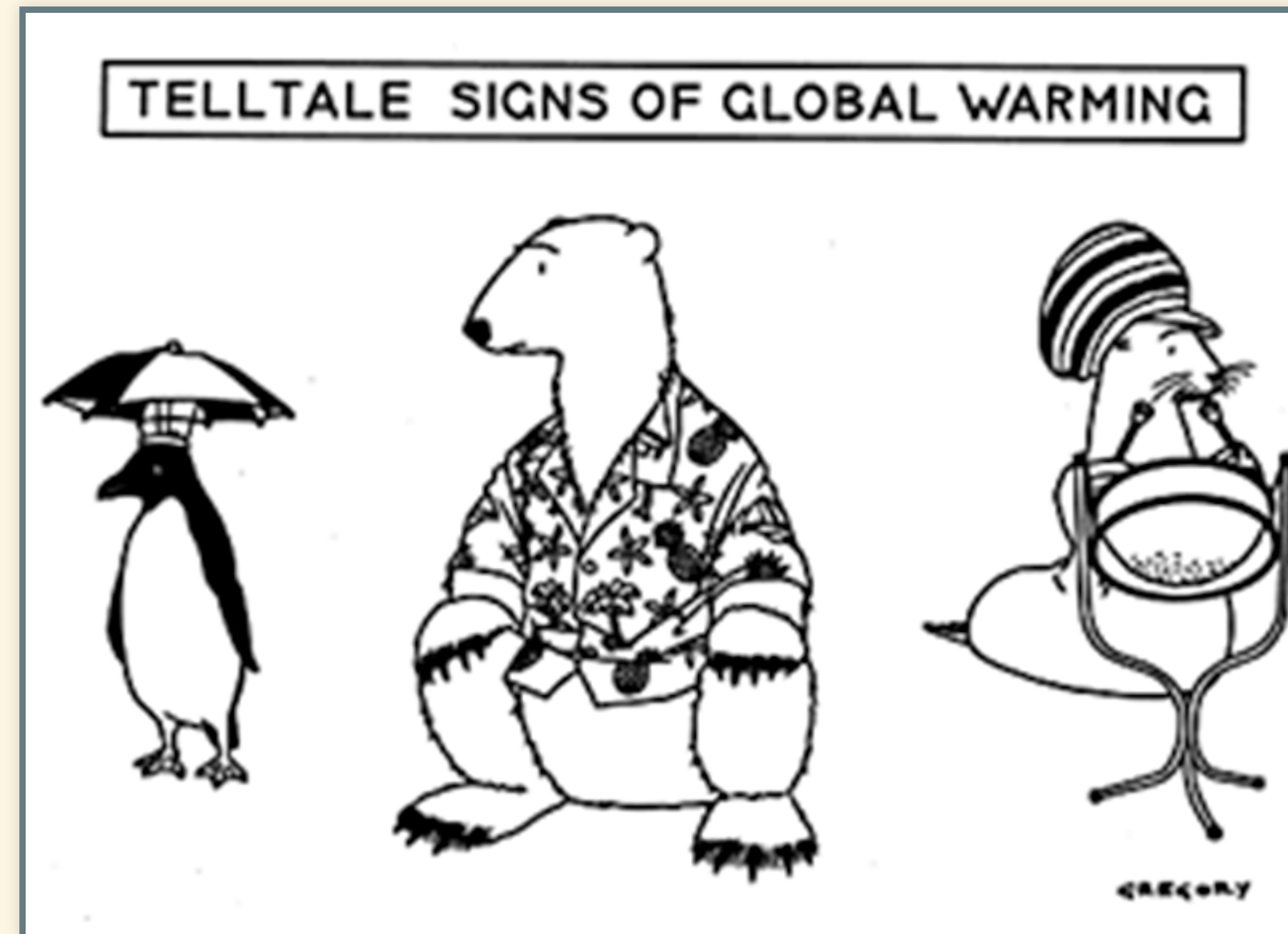


What Do You Want  
To Know About  
Climate Change?

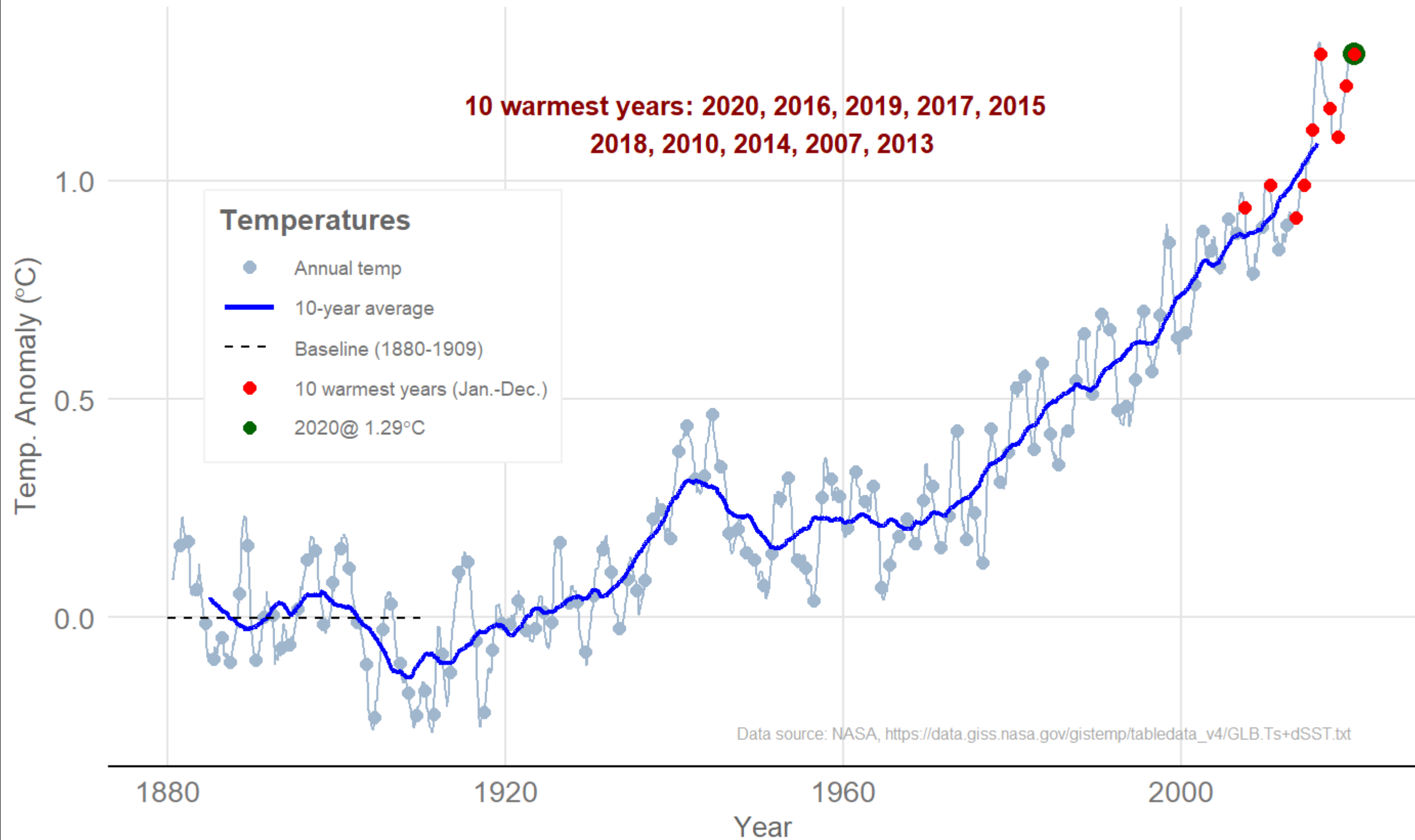
# What Do We Know About Climate Change?



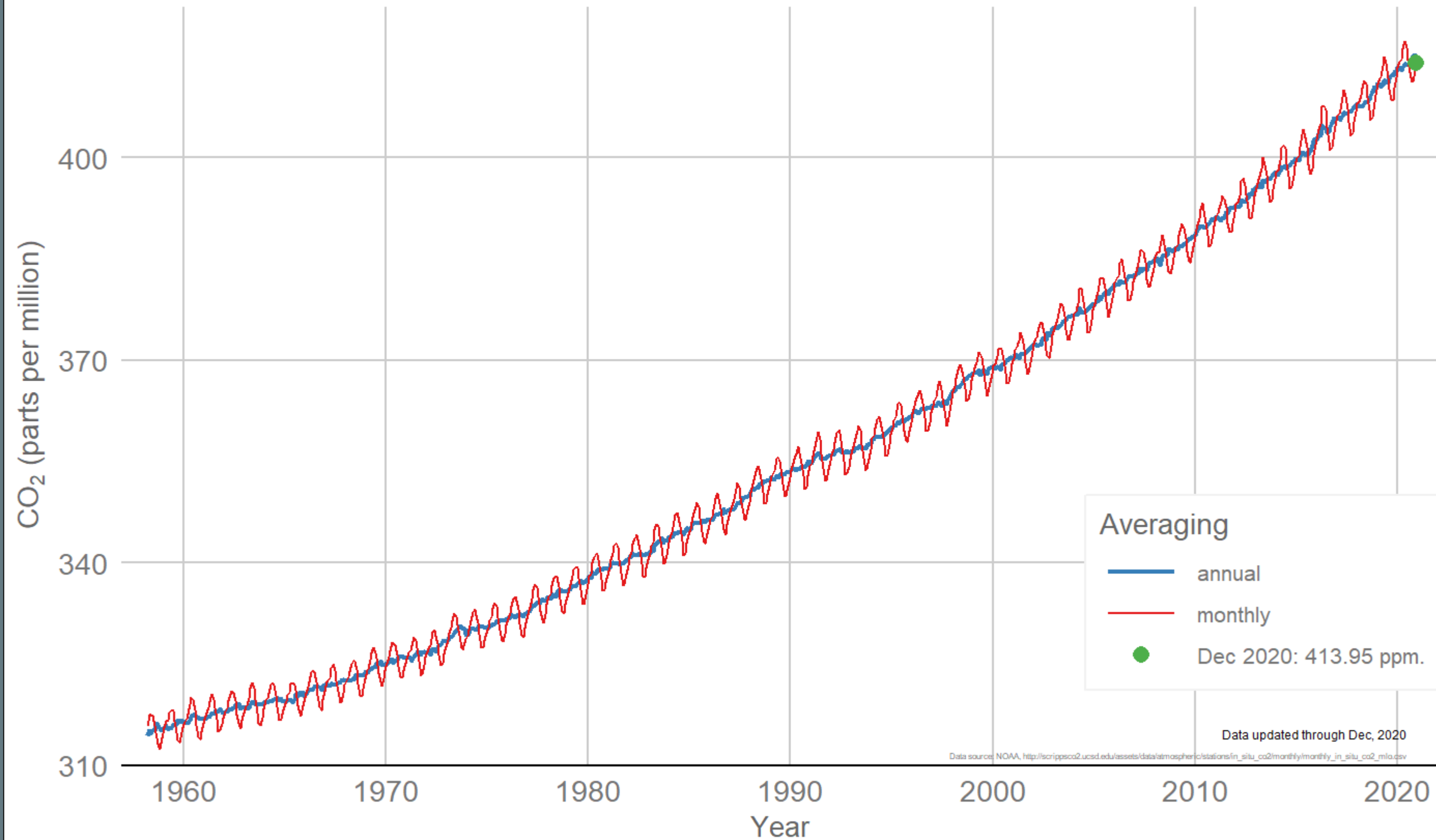
# What's Happening?



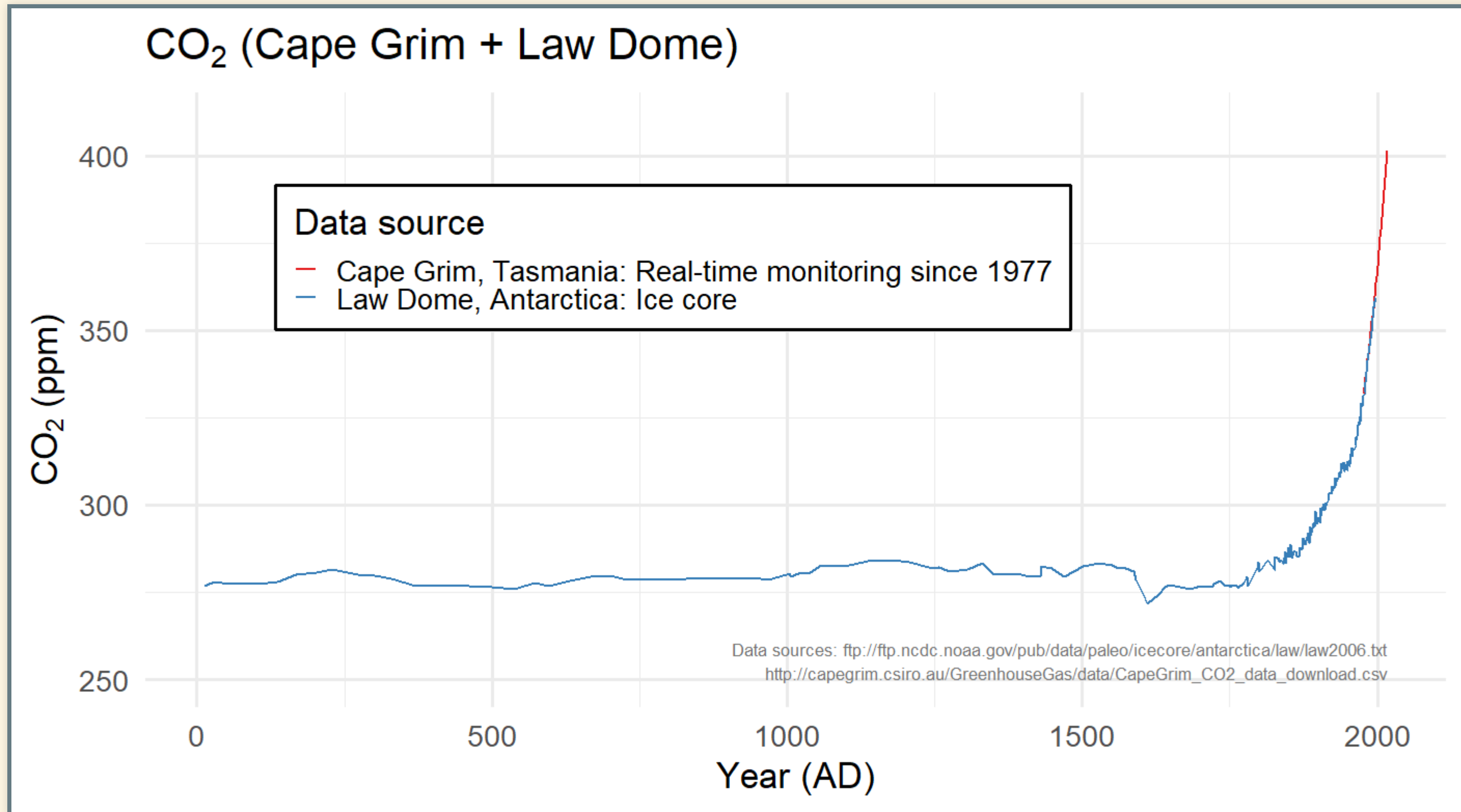
# Global Temperature Anomalies (1881 to 2020)



## CO<sub>2</sub> Trend Since 1958, Mauna Loa, Hawaii.



# Past 2000 Years



# 800,000 years of CO<sub>2</sub>

